Trauma Rounds

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Fingertip Injuries

LIONEL G. BROWN, MD:* Our first case (see Figure 1) is that of a 57-year-old healthy right-handed press brake operator. The patient had jacked his motor home up on blocks and it fell, crushing his right (major) index fingertip. There was no history of previous injury to the right arm or hand.

On examination, a volar-oblique amputation was seen of the soft tissue from the index finger, mid-middle phalanx, to the tip, exposing the insertion of the flexor profundus tendon and the bony phalanx. On the dorsum, the nail was avulsed. The patient was treated by a minimum of shortening of exposed bone under deep nerve block and tourniquet. A thin, split-thickness skin graft from the forearm was applied, he was given tetanus toxoid, and a course of penicillin. A short arm cast was applied. One week later, the cast was removed and there was a 90 percent graft take.

Three weeks postinjury, there was a small open area on the radial side of the amputation stump which was regrafted. The injury then progressed to complete healing. Two months postinjury, the patient returned to work with minimal sensitivity of his stump and a useful finger. The patient does not desire that any further surgical procedures be done.

The second case is that of a 31-year-old healthy right-handed die setter who caught the tip of his major long finger between a crossbar and guard of a cup conveyor belt. This resulted in a subtotal amputation through the base of the distal phalanx. No previous injury or problem with the hand was noted.

On examination, total transection of the right long fingertip was noted, just distal to the interphalangeal joint, except for a paper thin, narrow hinge of midvolar skin.

Under deep nerve block anesthesia and tourniquet technique, the amputation was completed, saving a short flap of volar skin. A thin, split-thickness skin graft was applied, the ulnar three fingers were immobilized in a forearm cast, and the patient was started on a five-day course of prophylactic antibiotics. One week later the cast was removed and there was a 100 percent graft take.

DONALD D. TRUNKEY, MD:† *Twenty to 30 percent of all accidents involve the hand. Fingertip*

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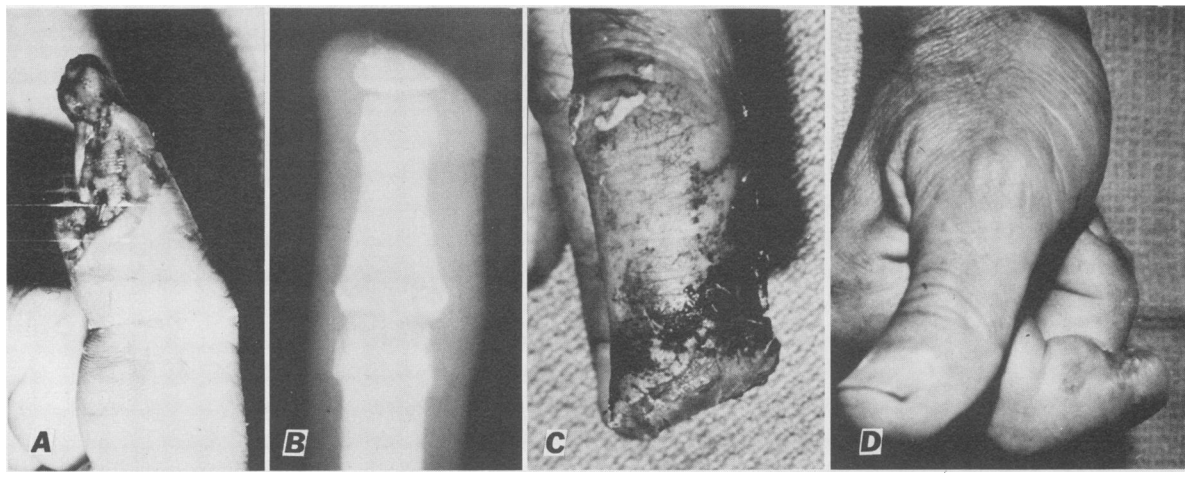

Figure 1.—A, injury in first case; **B,** x-ray film of index finger, first case; **C,** immediately following grafting; and **D,** three weeks after repair of injury.

injuries are so common that we have asked Dr. Eugene Kilgore and Dr. William Newmeyer to provide us with their concepts of proper management.

EUGENE S. KILGORE, JR, MD:* The disability caused by a fingertip injury is due to alteration in sensibility (that is, pain or numbness), loss of digital length, loss of stability of skin and bone, loss of endurance of skin to wear and tear, loss of nail function and nail cosmesis, and stiffness or deformity of the distal joint. This can be significantly reduced or enhanced by proper or improper treatment. One must appreciate that improper function of one digit tip may impair the function of the whole hand. Hence, the subject of fingertip injuries is important.

Injuries are either open or closed, tidy or untidy, dorsal or volar, radial or ulnar, or they involve the whole distal phalanx. Such categorization is important in considering treatment that will maintain basic function of the fingertip. The prime function of the distal phalanx rests on the following: (1) good sensibility without pain and adequate skin wearing quality on the surfaces that oppose in the act of pinch—for example, the ulnar side of the thumb and the radial sides of the index, long and ring fingers, (2) adequate length of the thumb and index (or the middle finger if the index is amputated), (3) stability of the skin, bone and distal joint and (4) adequate length of nails involved in picking up tiny objects.

Congestion develops rapidly after most injuries and is easily enhanced. All treatment must be directed toward its control, the elimination of dead space (for instance, clotted blood) and the restoration of good venous return and arterial flow. Throbbing pain is the prime signal of congestion and needs prompt physical rather than medical relief.

Most fingertip injuries are closed, being rendered by contusing or crushing forces. A congested fat pad or subungual hemorrhage that is very painful should be decompressed. To do this, we prefer to block the digital nerves and drill the nail or fat pad centrally with a No. 18 hypodermic needle mounted on a syringe. The hole remains patent for drainage if covered with a thick layer of zinc oxide ointment held in place with loose tube gauze.

Fractures are common and require serial x-ray studies for diagnosis and follow up. When there is little or no pain or significant displacement or instability, splinting may be optional, and at best, a padded metal guard on the digit. If pain is pronounced, a padded forearm boxing glove type of cast is recommended for a week or more to fully protect and rest the part. If there is significant displacement and instability, reduction and internal fixation is advised. For this, a longitudinally directed No. 19 hypodermic needle mounted on a 10 cc syringe is an excellent substitute if a Kirschner wire and drill is not available. The wire traverses the distal joint and is cut to allow protrusion well beyond the skin. It is usually withdrawn in four weeks, but the forearm cast may be replaced by a digit guard in one or two weeks. Administration of antibiotics is not necessary, but

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the finger should not be bathed until the pin is out. Basal intra-articular fractures may require an additional oblique small Kirschner wire, open reduction or even resection of the displaced fragment.

In the case of open injuries, the treatment will vary depending on how tidy or untidy the wound is. Prevention of infection can be achieved in most instances if dead space and circulation are satisfactorily attended to from the start, and if there is any doubt about either, antibiotics and antitetanus medications are immediately administered. Antibiotics are often applied to the wound during surgical procedures and given systemically at six hour intervals for at least two to three days. Tidy injuries are generally the result of puncture or cutting wounds. Puncture wounds are usually neglected. The patient keeps the digit active and dependent. In most instances he gets away with it, but occasionally seeks medical help because of progressive throbbing pain and the presence of a cellulitis or even an abscess (such as eponychia or paronychia on the dorsum, or felon on the volar aspect). The prophylactic treatment is elevation, immobilization and antibiotics. Treatment of an established abscess requires incision and drainage under tourniquet control and digital nerve block. The felon is drained where it points —usually in the center of the fat pad via a longitudinal incision. The nailfold abscess is drained by holding a No. 11 blade against the nail surface and scratching into the abscess which points into the crest of the nail fold. Drains are not needed if zinc oxide is kept on the wound for two to three days.

Tidy incisive injuries may be rendered without force by sharp metal or glass in which case the nail and bone are usually unharmed. When the cut is forceful, then the nail itself may be divided as well as the bone. Proper treatment requires the evacuation of clots under anesthesia and tourniquet control, as well as the use of 2 power loupe magnification. The wound may then be bathed with antibiotics and closed. We prefer 5-0 or 6-0 atraumatic monofilament nylon or Steristrips for skin closure. Fractures are treated as already mentioned under closed injuries.

Tidy amputations may be transverse or beveled and vary from split-thickness skin loss to loss of the whole distal phalanx. Over a period of 20 years, we have found that the most universally successful management has been the closure of any wound greater than 6 to 8 mm in diameter with a thin (for instance, 0.25 mm) split-thickness onlay skin graft taken from a volar-medial aspect of the forearm. This is delayed 24 to 48 hours if there is uncontrollable ooze or bleeding from the wound. This closure maintains length, reduces the chance of infection and makes it possible to start moving the digit and return to work quickly. Since most grafts shrink 50 percent or more, they tend to pull normal skin and fat over the defect to a sufficient degree in most instances to obviate any need for further time-consuming and costly surgical operations and disability. The graft is held in place with multiple strips of very narrow fine mesh Xeroform® gauze laid flat and smooth so as to stick and to close dead space. A stent of very wet gauze, tailored to the size of the graft, is placed on top of this and held with 6 cm strips of Reston® (1 cm and 2 cm wide) placed as sugar tongs over the digit at right angles to one another. This, in turn, is held with Tubegauze® or Kling®. A forearm cast is then applied to immobilize the wrist and injured digit. One or more adjacent normal fingers should be splinted along side the injured one for four to seven days to insure a 95 percent chance of a complete take (even on bone). A limited number of patients have symptomatic or troublesome stumps and need revision by shortening or the transfer of pedicle flaps. Full-thickness grafts (such as defatted fingertips) have not taken nearly as well as split-grafts and have not been functionally superior, so that we do not recommend them for fingertips. Reimplanted composite tips escharify and this only prolongs the disability. Amputation stumps in infants will generally epithelialize without grafting. When over half the distal phalanx of the thumb is tidily amputated, the filetted bone may be used with a tube pedicle to maintain its length. Sensibility can be restored with a neurovascular island pedicle. Tidy amputation of the whole distal phalanx may be considered for reimplantation with microsurgical techniques.

Untidy wounds about fingertips result from forces that cut and shred (for instance, cutting tools like saws and routers, and the like); forces that crush (hammers, heavy loads, closing doors); forces in motion that simultaneously crush and avulse (gears, conveyor belts, auto accidents, lariats, animal bites); and blasting and shattering forces (explosives, gun shots). The foremost problem is the hidden dimension of impaired circulation and the difficulty in determining viability of segments of tissue or of the whole distal phalanx. In some instances tissue survival may be

dependent on minimal amount of surgical dissection, suturing or other manipulation; while, in other cases, it may be dependent on the reduction and realignment of the displaced tissue. Whatever is done, however, must preclude any tissue tension. It is far better to leave a wound open and decongested than to close it and develop tension, dead space (and, possibly, infection) and set the stage for massive fibrosis.

In assessing viability, it may be better in certain cases to start debridement before inflation of the tourniquet, but once blood begins to obscure the tissue the arm (not finger) tourniquet must be inflated. A magnifying loupe should always be available.

Untidy lacerations of the volar fat pad may be closed with a few sutures if doing so does not cause tension, and there is infolding of skin margins or significant separation of the wounds without doing so. However, gently moulding the tissues and stabilizing them in position with strips of fine mesh Xeroform gauze, then strips of wet gauze, followed by Reston, in sugar tong fashion is often safer than sutures. Beware of trimming the ragged, though viable, edges of such wounds for fear of making the closure too tight.

Hopelessly mangled fingertips should generally be amputated and the stumps closed primarily or grafted. The loupe should be used to find and ligate the digital arteries with 6-0 nylon (not catgut, which is too reactive in the digit). The digital nerves should be similarly ligated and divided and allowed to retract into healthy fat. However, they must not be stretched.

A PHYSICIAN: *Would you describe the techniques used in the emergency room.*

WILLIAM L. NEWMEYER, III, MD:* I would like to respond to that question. Certain points of technique must be emphasized:

- The patient must be made comfortable (usually supine) during treatment.
- A tourniquet should be applied to the arm in every case and once tissue viability is established, inflated to 100 mm above systolic pressure. This is mandatory if pathology is to be properly assessed and dead space eliminated. Furthermore, in conjunction with anesthesia, it distracts the patient's attention from his anxiety and, contrary to belief, is well tolerated by young and old for 20 to 30 minutes. It is usually released after the wet dressing with gentle compression is applied.
- Two power loupe magnification and good light is essential.
- Skin preparation is with 1 percent or 2 percent solution of iodine in alcohol applied with a paint brush. This is kept out of the wound. The wound is moistened or irrigated with tap water.
- Anesthesia is rendered with 1 percent lidocaine without epinephrine. This is introduced through a ½ inch No. 26 calibre needle, slowly in small amounts (never enough to tense the tissues), in four quadrants at the base of the digit. A field block is given at the donor site for the skin graft.
- The instruments must be appropriate to do the job. For the most part, these should be plastic and include a sharp new razor blade and a clamp to hold it to take skin grafts. As mentioned, No. 19 or No. 18 hypodermic needles are good substitutes for Kirschner wires to stabilize fractures.
- Sutures should be nonreactive. We prefer monofilament nylon of 5-0 or 6-0 calibre (for instance, Prolene® with a "P" needle which is extremely sharp). Catgut, being reactive, is never used. The only exception is skin closure of infants where 6-0 plain catgut is used and obviates the agony of removing sutures.
- Dressings and immobilization make or break the case. They should protect the circulation and prevent dead space. Fine mesh Xeroform gauze applied in narrow strips, flush with the wound, keeps blood clots from forming about the surface and the suture knots. Beware of circumferential wrapping of gauze until a cushion of ¼ inch thick Reston is applied. Cast padding follows this and then, a fast-setting plaster cast as far as the mid-forearm to include the wrist. Wrist immobilization is essential for immobilization of the tip of a digit. One or more adjacent normal fingers should always be immobilized with the injured finger for the first few days. The thumb may be immobilized alone. Making a keel in the cast across the volar aspect of the wrist from mid palm to distal forearm gives the needed strength of the cast. The rest of the cast can be two or three layers thick for the sake of lightness, and cover the digits in a boxing glove fashion. All infants and other uncooperative patients need a long arm and heavier boxing glove cast of the whole hand for effective immobilization of even one digit tip. The

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hand is carefully cushioned with a roll of Kling or Kerlix® in the palm and Reston on the dorsum.

- Antibiotics should be directed at staph and strep and given prophylactically into all untidy wounds and continued systemically for at least two to three days at six-hour intervals. We are currently using lincomycin (500 mg every six hours) or cephalexin (250 mg every six hours).
- Elevation above the heart and release of all snug jewelry and clothing from the entire extremity is essential. This should be maintained for days, until the surgeon is satisfied that edema is not a problem.
- Analgesics are generally not needed. Significant pain requires inspection of the injury and if there is no tension then one is dealing with a psychological problem of a low pain threshold. Such patients generally do poorly regardless of treatment. If pain is throbbing, the tissue tension causing it must be released by physical means. This may require opening the skin or the wound.
- Dressings stuck to the wound should not be changed too frequently as long as the digit is comfortable. Simple lacerations and skin grafts may be changed in five to seven days. The dressings and splints of complex injuries to bone and nail bed are often best left alone for two to three weeks.
- The art of taking a skin graft requires a sterile towel on which lie a razor blade and a clamp to hold it, fine forceps without teeth, scissors to cut gauze, a strip of Xeroform gauze and four 2 × 2's. By "no touch" technique, these elements are kept sterile. The surgeon's hands are washed but ungloved. The donor site, the injured digit and adjacent digits are prepped with 1 percent or 2 percent iodine solution. Anesthesia is given. The extremity is elevated and the tourniquet inflated. A loupe is used to assure a thin even graft. The skin of the donor site on the volar inner aspect of the forearm is put under tension by one of the surgeon's hands wrapped behind the forearm and by a nurse tensing it behind the path of the razor blade. The blade is kept flat on the skin and advanced cautiously with rapid strokes by shoulder action and a stiff wrist. The graft is transferred to the digital wound by skidding off the blade. At times several grafts are needed. Sutures are unnecessary. They surgically traumatize the digit and provoke bleeding under the graft. The technique of dressing and splinting has already been described.